Supplemental feeding is a tool for enhancing northern bobwhite (Colinus virginianus) populations on hunting leases in South Texas. Feeding may be used to improve winter survival, reproduction and/or harvest of birds. Before implementing a feeding program, operators should consider management goals and the factors limiting quail populations. Feeding should be used only if native food quality or quantity is limiting. Type of feed, timing of feeding, and delivery of feed need to be considered. The cost of many current feeding operations ranges between $2.00 and $9.37 per acre.

Introduction

Wildlife is big business in South Texas. Indirect hunting revenues that bolster local economies are in the millions of dollars. Direct revenues from hunting leases range from $3.00 to $10.00 per acre. Lease costs for northern bobwhite (Colimus virginianus) are as high as $7.25 per acre (Guthery 1987). In comparison, many South Texas grazing leases range from $3.00 to $4.00 per acre.

Present market structure for hunting leases is weak (Clarke Adams, personal communication) and the days of easy lease dollars may be coming to an end. Many of the large corporate hunting camps have scaled down or closed. To make matters worse, more lands are now available for lease. Competition for the lease dollar will be more intense. Lessees will be less willing to pay for poor quality leases. Lessors and lease managers will need to take a more active role in wildlife management to ensure that a high quality lease or hunt is offered. One factor associated with the quality of a bobwhite lease is the number of birds on the lease prior to the hunting season (Guthery, 1987).

Supplemental feeding is an active management tool that is being used to increase bird numbers. There has been spirited debate in the wildlife management profession and among lay persons concerning the value of feeding programs. Much of the debate has been based on opinions, values and beliefs. Basically, those who think feeding will work use it and those who do not believe it increases populations do not feed. There is little scientific evidence that supports or refutes the utility of feeding. Few businesses survive economic hardships on guesswork. The objectives of this paper are to discuss the role of feeding, criteria and requirements for a successful feeding program and some of the economic implications of feeding. This work was funded by the Rob and Bessie Welder Wildlife Foundation (contribution No. 308).

Role of Feeding

There are three general objectives for feeding:

1. to improve bird survival;
2. to improve reproduction; and
3. to increase the probability of locating birds.

All feeding programs are based on several assumptions concerning the population, habitat, food supply and the feeding program.

Supplemental feeding will successfully improve bird survival and reproduction only if food supply is the principal factor limiting populations. Feeding cannot overcome deficiencies of habitat structure, excessive harvest or other limiting environmental factors (Robinson and Bolen 1984, Guthery 1986). Work by Kane and Guthery (unpublished data) and Doerr and Silvy (unpublished data) near Victoria and Sinton, Texas indicate that feeding was ineffective or had reduced effectiveness due to poor herbaceous structure. If habitat structure is inappropriate then habitat improvement, rather than supplemental feeding, should be the priority of management plans.

A second implied assumption is that the type of feed used is appropriate to meet the requirements that are lacking in the native food supply. One way to ensure the feed meets this requirement is to provide a whole ration. This is a balanced feed that provides all the necessary requirements of protein, carbohydrates, fats and minerals to ensure bird survival. The alternative is to provide a partial ration that supplies only one or two necessary components that the birds require and assume that all other nutrients are sufficient in the native food supply. Energy is a component in high demand by birds in the winter. Whole milo is a commonly used supplement that provides high energy (i.e., high carbohydrate and fat content) and is readily used by birds. Therefore, it is a good winter supplement. Whole milo is low in protein and mineral content and is inappropriate to meet the high protein demands of laying hens and chicks in spring (Wood 1986, Wood et al. 1986); also, it is not an appropriate
supplement by itself during the late spring through summer. At this time, a whole ration may provide the best results (Guthery 1986).

The final major assumption is that supplemental feed is available at the time when food is limiting reproduction or survival. Lehmann (1984) concluded that restricting supplemental feed before the native food supply is sufficient would eliminate any previous gains in survival that the feeding program produced. Conflicting results on the effects of feeding are in the literature. Many studies which report that feeding did not affect populations either did not document native food supply or found that the native supply was probably sufficient (Havera and Nixon 1980). Results from these studies do not adequately test the efficacy of feeding when the native food supply is insufficient.

Supplemental feed serves as an attractant and does increase the likelihood of locating birds. The degree to which feed will attract birds depends on the severity of the weather and the quantity and quality of the native food supply (Lehmann 1984, Doerr and Silvy unpublished data). The harsher the weather and the less native feed is sufficient, the greater the attraction of supplemental feed.

**Developing a Feeding Program**

The first step in a feeding program is identifying all land use objectives and noting any potential conflicts in the objectives. Second, define the objectives of the bobwhite program. Remember, feeding is only one tool in the overall bobwhite program. Examples of general bobwhite management objectives may be based on bird density (increase from 0.5 bird per acre to more than 1.0 bird per acre) hunting/flushing rate (flush a covey on the average of one per 15 minutes using dogs), or harvest (have 500 birds in the bag at season end). Third, determine the shortcomings in the existing habitat; are they related to structure, food supply or some other attribute of the system (predation, disease, water or lack of interspersion of habitat components). Notice that these steps involve planning and evaluation only. A successful bobwhite program requires these steps. Planning and evaluation can be simple or in-depth, depending on the desires of the individual. As the scale and cost of a contemplated feeding program grow, so should the planning and evaluation to ensure that the results are as predicted.

It cannot be over-emphasized that program objectives and anticipated responses from a management program must be aligned with the potential of the environment and the population. Population gains from a sound feeding program on an area that has poor food supply and good habitat structure will be greater and more rapid compared to population gains on an area that has poor structure. Similarly, population response to feeding will not be as apparent when the initial population density is low as when it is a moderate population density. The percent increase in the population may be as great or greater when populations are low; however, total number of birds "added" to an area will be lower. Increases attributed to feeding in South Texas have ranged from 0 (Kane and Guthery unpublished data, Doerr and Silvy unpublished data) to as high as 100 percent (Shupe and Guthery personal communication, Doerr and Silvy unpublished data).

**Types of Feeding**

The second major planning phase is to determine what type of supplemental feeding program will yield best results. This is done after evaluating the objectives and habitat limitations. Time span and type of feed are the two factors to consider. Feed may limit the population year round or only during one or two seasons. Research in South Texas suggests that two periods of time may be critical to improving survival and reproduction. Doerr and Silvy (unpublished data) found that native food supply from January through March limited bird survival on deep sands. Guthery and Koerth (1987) found bobwhite body condition was low in late summer. Guthery (personal communication) suggests that late summer may be a critical feeding period to enhance chick and adult survival in the western Rio Grande Plains.

Whole ration and partial ration supplements are the two general feed categories. Whole ration supplements supply all essential nutrients and minerals for birds to survive and reproduce. Partial ration supplements supply only a portion of the nutrients and minerals birds require to survive. The thinking implicit in a whole ration program is that birds will feed mainly on the supplement and the feed therefore needs to meet all nutritional requirements. It is also argued that a partial ration feeding program will not be as effective because birds would be forced to forage for other food items to complete dietary requirements. This would place birds at a greater risk to stress and predation by forcing birds to forage longer and during periods of inclement weather. The logic offered for using a partial ration supplement is that the nutritive portion in short supply is met and that all other nutritive requirements are found easily in native foods. Also, partial rations are less expensive, more widely available and pose fewer delivery problems than whole ration supplements.

There is no information specifically comparing whole ration versus partial ration supplements in bobwhite management. Laboratory work found that bobwhites could not survive on whole milo only. However, two field studies have demonstrated that whole milo can improve the survival rate of birds (Frye 1954, Doerr and Silvy unpublished data). None of the studies confirmed that reproductive success increased. Doerr and Silvy (unpublished data) have found that predation loss of radio-marked birds was lower on an area that received partial supplement compared to an area that received no feed. Work by
Shupe and Guthery (unpublished data) revealed that whole
ration supplements may have increased bird survival on a
South Texas area.

No information is available concerning effects of total
ration on bobwhite reproductive success. Two facets of
reproductive success are nest success and chick survival.
Higher quality feed for hens may increase clutch size;
however, nest loss is a greater concern than clutch size. It
also has been suggested that greater spring forb
production may alter reproductive success (Lehmann
1953). Several controlled experiments have demonstrated
that photoperiod is the principal stimulant of reproductive
condition (Mullin 1978). Work by Koerth and Guthery
(1987) has partially verified this by demonstrating that the
date when birds attained reproductive condition remained
fairly constant within a region. Therefore, feeding may
have a limited effect on nest initiation and success. Our
understanding of factors limiting chick survival is poor. If
proteaceous foods (especially insects) are lacking, then a
whole supplement that is high in protein content and is
also palatable to chicks may improve overall health and
survival. This is speculation and should be rigorously
tested before it is used on a large scale.

Application of the Feeding
Program

Design and execution of the feeding program is the
next step after it has been determined that bird numbers
need to be increased, that food is limiting the population
or will serve as an attractant and that feeding can
overcome the food quantity and quality problem. Three
facets of application are feeder design, feeder location and
feed storage and loading.

Feeder designs range from simple, inexpensive plastic
and metal drums to expensive apparatus with platforms,
timers and feed-flow adjustment mechanisms. Feeder bins
can handle 30 to 300 pounds and should be sealed to limit
moisture contamination and access to animals. No more
than 100 pounds should be loaded into a bobwhite feeder
at any one time unless there is little chance of the feed
becoming damp. Feed flow is gravity forced and usually
controlled by slits or small holes to limit the amount of
feed available at any one time. Better designed feeders will
have a device to restrict feed from flowing onto the
ground. This reduces the amount of feed lost and also
reduces the chance of birds ingesting feed contaminated
by water or fecal matter that will promote disease.

Limiting feed intake by nontarget animals such as
other birds, rodents, livestock and big game has been
attempted by several methods. Some feeders have battery-
or solar-powered timing mechanisms that will distribute
feed only at specific times. Some feeders have fences or
restricting bars to keep out larger animals. Hanging
feeders are an inexpensive way to reduce feed loss from
ants and rodents (Guthery 1986). Harvester ants can
remove up to 0.25 pounds per hour of whole milo on deep
sand and sandy loam range sites. Hanging feeders virtually
eliminate loss to ants. Feeders that swing freely also will
reduce the amount of damage to feeders and the amount of
feed taken by big game and livestock.

A few feeders have devices that will provide some
protection from predators. Whether these are important or
not is debatable. No bobwhite remains were found near
feeders in a South Texas study (Doerr and Silvy unpublished
data). This was based on more than 1,000 feeder-day visits.
During the same study, birds with radio transmitters were
less frequently lost to predators when feed was available
than when it was not. Also, all radioed birds lost from the
fed area were located at least 100 yards from feeders.
Observation suggests that behavioral traits may reduce the
likelihood of predators successfully taking bobwhites at
feeders. Bobwhite coveys rarely feed simultaneously at
feeders. Coveys remained at the feeder only if good woody
loafing cover was available. Also, coveys rarely spent more
than 15 minutes at a feeder. These data suggest that loss to
predators at feeders may be the least of an operator's worries.
Hawks may harass birds at feeders; however, hawks were
rarely seen (21 of 1,000 feeder-days) perched within 100
yards of feeders (Doerr and Silvy unpublished data).

Careful feeder placement and spacing can improve a
feeding program. Feeders should be placed next to good
woody loafing cover. Do not place a feeder in the middle of
woody cover unless you are sure you can easily service
it. This will reduce the time required for birds to find the
feeder and appears to increase the probability of birds
using the feeder. Doerr and Silvy (unpublished data)
working in South Texas, reported birds were seen less
often and trapped less frequently at feeders placed near
marginal woody cover. The same study found that radioed
birds were generally within 50 yards of feeders in woody
cover during cold, wet weather. The percent of harvested
birds with supplement in feed increased each month as
native food became scarce, and also increased during wet,
cool weather. This suggests that good thermal and loafing
cover in conjunction with a feeder may improve the
availability of feed for bobwhites when they need
supplement most. Feeders spaced 0.2 miles apart appear
to supply feed to the majority of bobwhites. This spacing
is based on studies that have concluded that most
bobwhite activities are encompassed in 72- to 80-acre
recommends placing feeders in strings of four or five if
complete coverage of an area is not desired. Feeders
should be placed in a systematic fashion to ensure
complete coverage of an area and ease of relocating
feeders to maintain and refill. Large operations might
consider numbering feeders and shedding paths to
guarantee all feeders are serviced at the appropriate time.


**Economics of Feeding**

Variation in the cost of feeding programs is a result of the expense of feeders, number of feeders used, type of feed and duration that feed is made available to the birds. Two feeding programs will be used as examples of low cost and high cost programs (Table 1). The lower cost program was a 5-month, partial-supplement program using restaurant condiment containers and 55-gallon plastic barrels. The more expensive program (Guthery 1986) was a year-round, complete-ration program using more permanent feeders. Feeders were placed every 40 acres (0.2 miles apart) on these studies.

Cost of feeders, exclosures and other capital costs comprised less than 70 percent of total operation costs (Guthery 1986). Costs of feeders on two study areas in South Texas were $3.00 and $10.00 with installation, respectively. Annual operating costs, including maintenance, feed and transportation, ranged between $1,150 and $5,700 for 16 feeders on 1 square mile (640 acres) (Guthery 1986, Doerr and Silvy unpublished data). This amounted to an annual operating cost per feeder of $75 to $355. Total cost on a per acre basis is between $2.00 and $9.37. Compare this cost to the income from leasing land for hunting ($3.50 to $7.25 per acre). Additional costs can be accrued for storage bins or sheds if feed is stored prior to use. A net gain of $1.25 per acre would be possible if the lease value without feeding was $3.50 per acre and the lease value increased to $7.25 per acre by using a low cost feeding program ($2.00 per acre). Feeding can be an economically sound management tool. Planning and a clear perception of management objectives are keys.

Other food improvement techniques such as discing and food plots may save money and yield equally positive results. However, the risk of having no production from food plots and discing needs to be considered. Feeding is not a panacea for all management problems. It only addresses food supply limitations. If habitat structure is inappropriate then the impacts of a feeding program will be severely limited.

**Literature Cited**


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**Table 1. Basic costs of 3 feeding programs in South Texas.**

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<tr>
<th>Expenses</th>
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<td>16 Feeders (cost/yr)</td>
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<td>Feed (1,500 lbs milo/feeder month)</td>
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*From Guthery (1986)